

ACCOUNT

OF SOME

Experiments and Observations

ON

TAR-WATER:

Wherein is shown the QUANTITY of
TAR that is therein.

AND ALSO

A METHOD proposed, both to abate that
QUANTITY considerably, and to ascertain
the STRENGTH of the TAR-WATER.

Which was read before the ROYAL SOCIETY.

By STEPHEN HALES, D. D. F. R. S.

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I.

I. **A**S the celebrated Tar-water, recommended by the worthy and learned Bishop *Berkeley*, is said to be taken with great Benefit by some, and Detriment by others; I thought it might probably be of use to inquire whether any, or what Quantity of Tar, there was in Tar-water, made with different kinds of Tar, different Degrees of stirring, and in different

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ferent Ways of making it. A short Account of which I shall give, without interesting myself, either in Favour or Disfavour of a Medicine that is under the Inspection of the proper Judges, as well as of all the rest of the World.

2. UPON Inquiry from knowing Persons, I find that *Norway* or *Swedish* Tar, which is dark, thick and clear, without obscure Grains in it, is accounted the best, for the general Uses of Tar: But that the Tar which is made of the Tops of Fir-Trees, which are become very hard, by having lain long dead on the Ground, after having either fallen of themselves, or being killed by the draining off their Turpentine Sap, thro' Basin-like Notches cut near their Bottoms: (These Tops are commonly called Light-wood, the poorer People making use of them instead of Candles:) This Tar being burned in a very strong Fire of such

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dry

dry Wood, is of a very caustick, corroding Nature, so as to be hurtful to Ropes, &c. for which reason it is not used in the Royal Navy. But the *American* Tar, which is made of green Fir-Trees, with a less degree of Fire, is esteemed good, and is called green Tar ; for which reason a Bounty, double the Value of the other, is allowed by the Government here, on Importation.

3. HAVING procured some *Norway* or *Swedish* Tar, which was thirty Years old, and very thick and stiff; I, according to the Bishop's Prescription, made Tar-water in the proportion of a Gallon of Water to a Quart of Tar, stirring it four Minutes: I then took a Pint of this Tar-water, and evaporated it away in a *Florence* Flask, cut to a wide Orifice, with a red-hot circular Iron, and weighed. Besides what flew off in Evaporation, there remained at the Bottom of the Flask

forty-four Grains of thick, dark, reddish Tar, of a bitterish burnt Taste. On evaporating a like quantity of Tar-water, made with common, coarse, stiff *American* Tar, in the same manner, there remained twenty-eight Grains of a like syrupy Tar; and sixty-one Grains in a Pint of Tar-water made with a stiff Tar, just brought from *Norway*. This Water was high coloured on standing some days.

4. I evaporated away also a Pint of Tar-water, made with the old Tar, which had been stirred for half an Hour, in order to try how strongly it might be impregnated with Tar. There remained ninety-three Grains, which Residium was not all of it a syrupy Tar, as the former, but partly incrusted on the Sides of the Flask; which shews how much more of the groffer Tar was incorporated in this Water than in the other. This was also evident by its greater and more lasting

lasting Froth on shaking, and also by its deeper Colour, it becoming brown as Beer, on a few Days standing: And even the thinner kind of Tar, which was stirred for eight Minutes, had twenty-six Grains of Tar left, on Evaporation of a Pint of its Water. Hence we see the Effects of stirring Tar-water much.

II.

5. **F**INDING forty-four Grains in a Pint of the first Water, Section or Numb. 3. it occurred to me, that probably there might be less Tar in the Water, if it could be made without stirring it with a Stick, which stirring may impel some of the grosser Tar into the Water, whence its too heating Quality is with good reason thought to arise. I therefore put half a Pint of Tar into a Tin Pot, whose Bottom was punched full of Holes, one sixth of an Inch in Diameter, and half an Inch

Inch distant from each other ; which I found to be a proper Size for this very thick Tar ; thro' which the Tar dropped gradually into a Quart of Water, when placed in hot Sunshine ; or else at such a distance before a Fire, as would give a like Degree of Heat, sufficient to make it drop. But finding, on evaporating off a Pint of this thus prepared Tar-water, with Warmth, thirty-two Grains of thick Tar ; for it is well known, that Fluids in a warm State will imbibe a greater Quantity of Matter, than when cold : I made another Tar-strainer, being a Box of Wood, which was square, and two and an half Inches wide in the Clear within, and eight Inches deep, with a Pewter Bottom, which had twenty-five Holes in it, one eighth of an Inch in Diameter : There was also a wooden Plug or Rammer, whose bottom part was exactly fitted to it ; by which Plug, the cold Tar was gradually forced, in slender Streams, like Rain, thro' the

the Bottom of the Strainer. There were fixed on each side of the Strainer Pieces of Wood two Feet long, like the Poles of Chairmens Chairs, on these the Strainer rested at a proper distance over the Pot of Water.

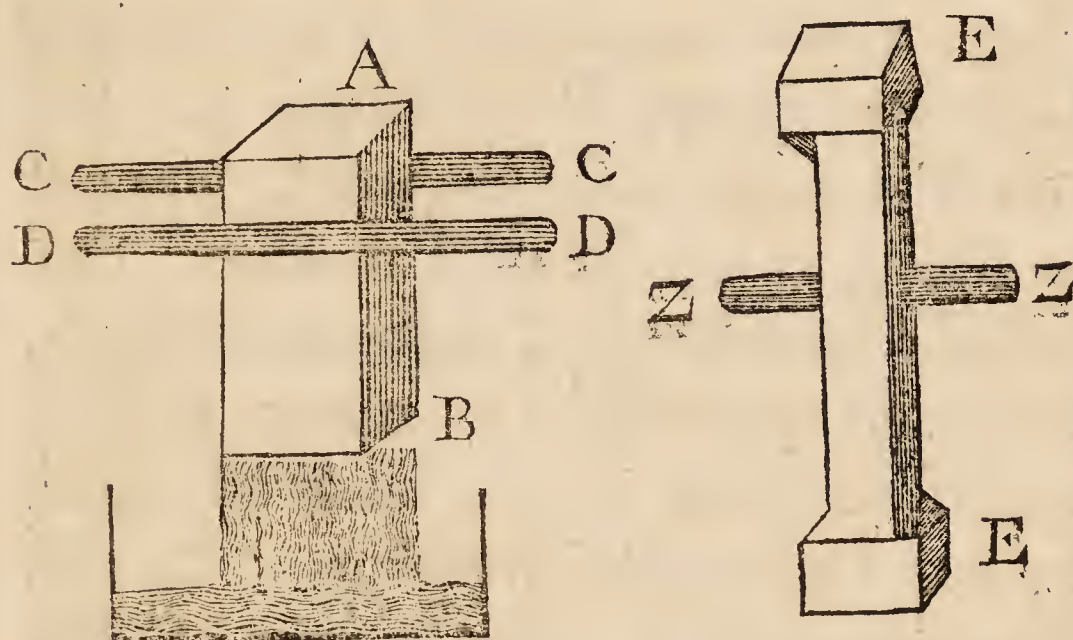


Fig. A B the Strainer-box. C C D D the Arms or Poles two Feet long to rest it on. E E the Plug. Z Z, a wooden Pin, which hindered the Bottom of the Plug from pressing hard on the Bottom of the Strainer.

I found but eighteen Grains of syrupy Tar, on evaporating a Pint of Tar-water thus prepared, by the same old Tar's dropping

dropping five times on it : And but six Grains in a like Quantity of Tar-water, made by dropping coarse *American* Tar five times on the same Water ; whereas in a Pint of Tar-water made by stirring some of the same Tar, there remained twenty-eight Grains of syrupy Tar, Numb. 3. But this Tar-water thus prepared, was not so strong as the stirred Tar-water, tho' it had a considerable Degree of Strength, sufficient probably for many Cases ; and if requisite may be made stronger, by more repeated Droppings. By this means there is a large Surface of Tar exposed to the Water, to be thereby impregnated with the Virtue of the Tar, without forcing in the grosser Parts, by stirring with a Stick : For it seems probable, that there is not so great a quantity of the Surface of the Tar exposed to the immediate Contact of the Water in stirring so stiff a Mass of Tar, as in the dropping way. This being something like Nature's Method
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of impregnating mineral Waters, with the Virtue of *Petroleum*, or Tar of the Earth, as they gently glide among it : By this means likewise, there will be a greater Certainty, in adjusting the Strength of Tar-water ; for the Strength of the Water will be proportionable to the numbers of the several Droppings, be they one, five or more.

6. I dropped the same half Pint of Tar, into twelve different Quarts of Water, till it became pretty insipid as to the saline, acid Taste, tho' it had still a tarrish Taste. The Acid, in which the Virtue is thought principally to reside, might be sensibly tasted in the fourth Quart, and farther ; for the Drops of Tar are in every Operation formed, partly with a new Surface to expose to the Water. And it is observed in the Distillation of Turpentine, that some of this acid Spirit arises to the last, being still intangled in the Turpentine.

7. WHEN Tar-waters of different Degrees of Strength were put into *Florence* Flasks, with other inverted Flasks fixed on them, and all were placed in the same Vessel of hot Water ; on breaking the upper Flasks, the volatile acid Spirit could very sensibly be tasted, especially that of the stronger Tar-water ; which shows that these Waters are impregnated therewith : and which, when distilled from Turpentine, Dr. *Boerhaave* in his Chemistry says, is the best vegetable Acid that is known. This Acid in Tar-water will curdle Milk ; yet Turpentine-water will not curdle Milk : which shows that Tar is considerably acidulated, by the Action of Fire in making. I find in a Pamphlet, intitled, *An Answer to a Letter to the Right Reverend the Bishop of Cloyne, occasioned by his Treatise on Tar-water*, that on distilling twenty-two Pounds of the best *Norway* Tar by two Retorts, there was

Acid

Pounds. Ounces.

Acid Spirit ————— 1 2 $\frac{1}{2}$

Oil ————— 7 13

Pitch ————— 12 14

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21 13 $\frac{1}{2}$ Loft ————— 0 2 $\frac{1}{2}$ —————
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III.

8. **B**UT having procured four several Quantities of *Norway* or *Swedish* Tar, which was not so stiff, but more soft and oily than the Tars mentioned in Numb. 3. and which were esteemed by the Dealers in Tar to be very good for the common Purposes of Tar; I found much less Tar in the Tar-waters made with these, *viz.* only between five and fifteen Grains; and that, whether the Water were made by stirring four Minutes, or by dropping the same Tar five several times on the same Water, thro' the above-

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mentioned

mentioned Strainer ; so that the Strainer was of little use, to lessen the Quantities of Tar, in these kinds of Tar-waters ; tho' of use, the better to adjust the several Degrees of Strength desired : And also of considerable use, in abating the Quantities of Tar, in the Tar-waters made both of the stiff Tars, and also of the coarse *American* Tar, as appears by comparing the Events of each Manner of Preparation in Numb. 3, and 4. where it was found that the Tar-water made with the stiff Tar by stirring, had, in a Pint of it, forty-four Grains of *Residuum* ; and by dropping, eighteen Grains. The coarse *American* stiff Tar had twenty-eight Grains by stirring, and but six by dropping. But it was observable, when the Tar dropped on the Water thro' the Strainer, that the Quantity of Oil which separated from two of these thinner Tars, as it floated on the Surface of the Water, hindered the dropping Tar from sinking into the

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the Water : For which reason it was needful, from time to time, to put the swimming Oil and Tar gently by with a Stick, and make it sink : But the Oil of the other Tars did not prevent their sinking down to the Bottom of the Water. Some of these Tars dropped very well through Holes, which were one eighth of an Inch in Diameter, without being forced through with the Plug.

9. 'Tis probable, that the greater Degree of Oilyness of these thinner Tars may prevent, in some measure, the grosser Tar from incorporating with the Water in stirring. And perhaps, on the same account, they may likewise have something less of what is called the acid Spirit : for the Water made with old, stiff, less unctuous Tar, and with stiff *Norway* Tar, seems to taste sensibly stronger of the acid Spirit, than that made with thinner,
more

more unctuous Tar ; on which account the stiffer would be preferable, were it not, that it communicates too much of its grosser Parts also to the Water ; which yet is in a good measure prevented by the Strainer, as was found in Numb. 5. The Water made with the thinner Tar tastes much stronger of Soot, than that made with the stiff Tars. These stiffer Tars may probably be the latter Runnings of Tar in burning, for the last Runnings are so stiff as to be Pitch : so that the first Runnings, which come off with a small Degree of Fire, may probably therefore approach nearer to the Nature of Turpentine than the latter.

10. SOME of the more volatile Parts doubtless fly off in making Tar ; for, as Dr. *Boerhaave* observes, the subtile, Æthereal Oil of Turpentine rises with a Heat equal to less than half the Heat of boiling Water ; which is of so very
penetrating

penetrating a Nature, that being anointed on the Surface of the Body, it will soon give a violet Smell to the Urine; but Drinkers of Tar-water inform me, that it does not give a violet, but tar-rish Smell to the Urine.

IV.

II. **W**HEN we consider, that in burning Wood close covered up, either to make Charcoal or Tar, a considerable Quantity of the essential Salt is turned, by the Action of Fire, into fixed alkaline Salt; it seems not improbable, that a considerable part of whatever Virtue Tar-water has, may be owing not only to the subtile, volatile Acid of the Tar, but also to a fixed alkaline Salt, intimately united with the Oil of the Tar, and making thereby a penetrating, deterfive Soap. In the same manner as *Tachenius's* Salt is made, by burning Rosemary in a covered Vessel, whereby the fixed Salt and Oil are intimately united, and thereby

thereby become a mild, alkaline, saponaceous Substance, which, as Dr. *Boerhaave* observes, will mix well with the Humours of the Body. And may not even the subtile, volatile Salt, by the same means, be united with the subtile Oil, and thereby become a very penetrating, deterfive, and attenuating volatile Soap?

V.

12. **I** Filtrated these several Tar-waters, thro' filtering Paper, yet no Tar, nor oily Substance, remained in the Paper; not even of that Tar-water, which had no less than ninety-three Grains of Tar in a Pint of it, Numb. 4. nor were the filtering Papers, when dry, any more inflammable, where the Tar had passed, than in other Parts, which had not touched the Tar-water. Nor was the filtering Paper of the thinner Tar at all discoloured, tho' that of the stiff was as if smoaked. Hence we see how intimately and minutely the
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the Tar is mixed with the Water. No wonder then, since Water conveys so much Tar thro' the Filter, that it should also be a Vehicle to convey great Quantities of Tar into the Blood, as well as the Medicinal Virtue also into the finest and remotest Vessels of the Body, in the same manner that the Virtues of Mineral Waters are conveyed.

13. AND as Tar is thus incorporated into the Water by stirring, so is the Water also thereby mixed with the Tar, so as to increase its Bulk very considerably. There is also a Water which separates from Tar, some time after it is made, and that in such Quantity, as to lay three or four Inches deep on the Tar. This Water, which is very strongly impregnated with the acid Spirit, is, as I am informed, drank by the *Americans*, as a Cure of some of their Maladies.

14. I observed that a Quart of Water, which had half a Pint of Tar stirred in it for four Minutes, was sensibly stronger than two Quarts of Water made with a Pint of Tar stirred as long a Time. And there is good Reason why it should be so: for tho' a Pound of Sugar or Salt, by dissolving thoroughly, will make a double Quantity of Water, just as sweet or salt, as half a Pound will, half that Quantity of Water; yet as a large Quantity of so thick and unctuous a Substance as Tar is, cannot, by equal Times of Stirring, be so thoroughly stirred, as a lesser Quantity can; so neither can its double Quantity of Water have so strong a Tincture of the Tar, as the smaller Quantity of Water: but in the dropping way, the Strength will be in proportion to the repeated Numbers of Droppings.

15. As Tar by stirring becomes of a lighter brown Colour, so it will recover its darker Colour by standing; and that soon, if warmed.

16. IN these Evaporations of Tar-Water, Care must be taken to watch, when the Sediment begins to have a Syrup-like Thickness, and then to cease the Evaporation, else no certain Estimate can be made of the Quantity of Tar; because a great Part of it would be lost by continuing the Heat.

VI.

17. **A**S Tar and Turpentine are the Juices of the same Kinds of Trees, only procured in a different Manner, (the Turpentine being drawn off by Notches cut in the Fir-Trees while standing; but Tar is procured by laying Fir-wood in great Heaps, and burning it while covered, with Sods or Turfs, which causes the Tar to run out at the Bot-

tom of the Oven, as it is called, in the same manner that Sap flows from Heaps of common Wood, while burning into Charcoal :) And as Tar-Water differs much from Tar taken in the gross, so may Turpentine-Water also differ from Turpentine : I thought it therefore not improper to repeat the same Experiments on Turpentine as on Tar.

18. BUT as there is a wide Difference between the mild, native, essential Salts of Vegetables, and the same Salts, which, when they have undergone the Torture of Fire, are become very caustick ; so there may probably be a considerable Difference, in the Medicinal Virtues of Tar and Turpentine-Waters.

19. I made several Turpentine-Waters, both by stirring and dropping, with the same Proportion of Turpentine and Water, as of Tar and Water ;
and

and found, that by stirring four Minutes, it had a too offensive, bitterish, and peculiar Turpentine Taste.

20. I stirred the same Half-Pint of Turpentine, in twelve different Quarts of Water ; toward the latter Stirrings, the Turpentine grew less and less unctuous, so as to adhere but little to the Stirring-stick ; nor was it disposed to sink in the Water so much as at first, being more spongy by much stirring ; and it became almost as white as Paint of white Lead. The latter of the twelve Stirrings were gradually milder, and much less bitter, than the former ; the Water was very little discoloured thereby.

21. THE first and strongest of these Waters passed through the filtering Paper, without leaving any visible Turpentine ; nor was that Part of the Paper, through which it passed, more inflammable when dry, than the other Part ;

Part ; yet on evaporating away a Pint of this Water, there remained fix Grains of grofs Turpentine ; and three Grains in a like Quantity of the twelfth Water.

22. WHEN a like Quantity of Turpentine was dropped in very slender Threads, thrice on the same Water, thro' a Strainer, whose Holes were one sixth of an Inch in Diameter, it had a disagreeable Taste of Turpentine; and yet there remained but two Grains of Turpentine on the Evaporation of a Pint of it.

23. BUT on only once dropping of the Turpentine, it had a mild, balsamick Taste, which was not disagreeable : Tho' with *Venice* Turpentine, which is drawn from the Larch-Tree, it had a stronger, more disagreeable Taste. There was a thin Oil, which separated on the Surface of the Water, from the *Venice* Turpentine.

And

And as this Oil made the Turpentine float upon the Water, it was therefore requisite from Time to Time, gently to make them sink with a Stick, that the dropping Turpentine might touch the Water. But there was no thinner Oil separated from the common Turpentine in dropping on the Water, as there does from some Tars, whose more subtile Oil is separated from them by the Heat of Fire, in making the Tar.

VII.

24. **A**S these Tar and Turpentine-Waters were made with sweet Rain-water, in which there were Water-Gnats, (for the Waters still continue to produce innumerable flying Creatures, in conformity to the great Command, at the first Institution of Nature;) so it was very observable, that these Water-Gnats, and other small Insects, died, the first in six or eight Hours, the latter in thirty or forty Hours, in
Tar-

Tar-Water ; yet neither of them were killed in the strongest Turpentine-Water that I made ; but continued brisk and lively for several Weeks : A probable Argument, that there is but little gross Turpentine incorporated in the Water, for Turpentine kills Insects.

25. THO' the Degree of Fire which Tar undergoes in making, has made it thus destructive of the Lives of those small, tender Animals, yet we cannot thence infer, that Tar-Water is pernicious to Mankind, for the most caustick *American* Tar may be best in some Cases; there being several powerful and safe Medicines, which have undergone the most intense Degrees of Fire, and are consequently become thereby so much the more caustick, so as instantly to kill such little Animals ; an Instance of this, is Salt of Wormwood. Thus also all kinds of fermented, distilled, spirituous Liquors, which are rendered so caustick, by the Heat

Heat of Fire which they undergo in Distillation, that they will instantly kill such Insects, yet have not the like Effect on Men : tho' happy were it for Mankind if it were so ; for that would effectually deter them from that destructive Pest, which, by its caustick burning Quality, however disguised with agreeable Flavours, and the plausible Name of Cordials, gradually destroys the Vitals, and thereby prematurely quenching the Lamp of Life, precipitates into their Graves vast Multitudes daily and yearly all over the World. How valuable a *Panacea* would Tar-water be, if it were as effectual a Remedy in preserving, as the other is in destroying Lives ! Were it possible in the Nature of Things, that there could be such a Thing as a *Panacea*, in the vulgar Sense of the Word, it was never more wanted than in the present Age, to counter-act that great Bane of Mankind. But the present precarious and more uncertain State

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of

of Health and Life, are better suited to our degenerate State, in order to restrain from farther Degeneracy, than such a sure Resource for Recovery of Health would be. Yet how eagerly do Mankind catch at every Semblance of a *Panacea*, in hopes to prolong the present Life; tho' but too neglectful of that truly salutary Water of Life, which kind Providence tenders us, in order to extend Life thro' a happy Eternity!

VIII.

26. **I** MADE also the like Experiments with *Barbadoes* Tar; this being a *Petroleum*, or Mineral Tar, which issues out of the Earth, with Water from whose Surface it is scummed; and therefore a very different thing from the above-mentioned Tar of Fir-Trees. I stirred three Spoonfuls of it for four Minutes, both in a Quart of cold and hot Water. The Taste of both these Waters was soft, mild, and
not

not disagreeable ; that made with hot Water was something the stronger tasted. It will not curdle Milk, nor kill little Water-Insects. Being filtrated, it leaves no inflammable Matter in the filtering Paper, tho' the Paper is a little discoloured. On Evaporation of a Pint of the Water, the more subtile, volatile Parts flying away with the Heat, there remained five Grains, of a thin-spread, water-coloured transparent Substance, of a pungent, saline Taste, which would not ferment with Spirit of Nitre. I am informed that some in *Dublin*, have drank this instead of the other Tar-Water.

27. DR. *Meighan*, in his Treatise of the Nature, and very powerful Efficacy of *Bareges* Waters, in the *Pyrenean* Mountains, both by bathing and drinking, finding that their Virtue consisted in a *Petroleum*, with which they are richly impregnated, proposes, for the Benefit of those who cannot go

to *Bareges*, the impregnating Water with *Petroleum*, for the like Purposes, as a substitute Remedy, where we cannot imitate the Perfection of Nature's Preparation.

28. WE have seen in the Course of these Experiments, the Quantity of Tar that there is in Tar-Water; and the great Difference of that Quantity, made with different Kinds of Tar, and different Degrees of Stirring. Now, since, notwithstanding these Quantities of Tar, and the additional more subtile volatile Oil, which flies off in Evaporation, it has yet undoubtedly proved an efficacious Remedy in many Cases and Instances; it may hence be reasonably concluded, that the Medicinal Virtue of the Water does not reside solely in the Acid, but partly also in the unctuous oily Parts, which are so temper'd by the Acid, as in some Cases to prevent their heating too much. But whereas in some Cases, it is observed

served by Physicians, to be too inflammatory, it is probable, that heating Quality, may in some Degree be abated, by making Tar-Water, with the Strainer above-mentioned, without Stirring ; thereby to divest the Water of a good Quantity of its groffer, tarrish Particles, and yet retain whatever Powers it may have to do good. It is hoped, that the Light given by these Researches, may be of use in skilful Hands, for regulating and adapting the due Proportions of the acid, and the oily Principles, to different Cases and Constitutions. This is the proper Province of the Physician, which I am no ways qualified to meddle in.

F I N I S.

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BOOKS written by Dr. *HALES*, and
fold by R. MANBY and H. S. Cox.

I. *S*tical Essays; containing Vegetable Staticks; or an Account of some Statical Experiments on the Sap in Vegetables: Being an Essay towards a Natural History of Vegetation; of use to those, who are curious in the Culture and Improvement of Gardening &c.

II. Statical Essays; containing Hæmastaticks; or an Account of some Hydraulick and Hydrostatical Experiments made on the Blood and Blood-Vessels of Animals.

III. Philosophical Experiments; containing useful and necessary Instructions for such as undertake long Voyages at Sea. Shewing how Sea-Water may be made fresh and wholesome; and how fresh Water may be preserved sweet. How Biscuit, Corn, &c. may be secured from the Weavel, Maggots, and other Insects; and Flesh preserv'd in hot Climates, by salting Animals whole.

IV. A Description of Ventilators; whereby great Quantities of fresh Air may with Ease be conveyed into Mines, Gaols, Hospitals, Workhouses and Ships, in Exchange for their noxious Air. An Account also of their great Usefulness in many other Respects: as in preserving all Sorts of Grain dry, sweet, and free from being destroy'd by Weavels, both in Granaries and Ships: and in preserving many other Sorts of Goods, as also in drying Corn, Malt, Hops, Gunpowder, &c. and for many other useful Purposes.

